

## EXTENDIBLE FLEXIBLE ELECTRICAL CONDUIT WITH CONDUCTORS THEREIN

### **Background of the Invention**

**[0001]** Flexible spiral wound conduits are well known for carrying and protecting electrical conductors, sometimes referred to as “goosenecks”. Such flexible conduits have recently become miniaturized and used to carry internal wiring for communications purposes such as microphone holders. Also well known are telescoping coaxially sliding tubes used as conduits to extend or contract the conduit. These are used with swivel table lamps and also to hold microphones. Each of these two different types of conduits has utility for specific applications. For example, spiral wound flexible casings may be bent universally in different directions and hold the bent position, but are non-extendible. On the other hand, telescoping tubes will extend and contract in a single direction, but are not bendable or flexible, and require universal joints or pivots at their ends to change their orientation.

**[0002]** U.S. Patent 5,065,299 issued November 12, 1991 to Cohen discloses a power extendible lamp, wherein short telescopic sections of non-circular cross section appear to give limited flexibility to a lamp holder. Limited curvature is apparently achieved by utilizing many very short telescopic sections.

**[0003]** U.S. Patent 3,324,254 issued June 6, 1967 to Shaw et al. discloses a microphone holder with a rigid telescoping section containing microphone wires which collapse into the space between the ends of the telescoping tubes when the unit is contracted. A jam nut is required to hold a desired position, and provision for vibration reduction is also added. A pivot pin and a swivel mounting allow for movement of the microphone in different directions.

**[0004]** U.S. Patent 2,209,912 issued July 30, 1940 to Deems illustrates a telescoping underground protective conduit for armored electrical cable, which is helically wound inside the inner telescoping tube to permit raising the upper end of the assembly.

**[0005]** There is a need for a flexible extendible conduit which will accommodate a number of conductors, which allows full freedom of direction at one or both ends of the conduit as well as the ability to extend and contract in length. All of this should be suitable for ease of manufacture in miniaturized form, so that it could be used for applications such as microphone holders, small lamps and the like. In addition, it

would be desirable to lock the telescoping section in a desired place without the need for a jam nut which is commonly employed today in microphone holders. Also there is a need for an extendible flexible conduit which reduces vibration or shocks due to impact.

**[0006]** Accordingly, one object of the present invention is to provide an improved extendible flexible electrical conduit with conductors therein.

**[0007]** Another object is to provide such an extendible flexible electrical conduit with means to lock the extendible section in place.

**[0008]** Another object is to provide such an extendible flexible electrical conduit which reduces shocks and vibration along the conduit.

### **Summary of the Invention**

**[0009]** Briefly stated, the invention comprises an extendible flexible electrical conduit with conductors therein comprising at least one spiral wound flexible casing, a rigid telescoping section connected thereto and having insulated electrical conductors extending through the conduit. The conductors are arranged inside the telescoping section, preferably by bunching up or helically winding the conductors so as to allow them to extend and contract to accommodate extension and contraction of the telescoping section. The telescoping section comprises inner and outer tubes that are slidably and coaxially disposed to allow the telescoping section to extend and contract. In order to limit rotation of the inner tube with respect to the outer tube, the outer tube is preferably oval along most of its length and the sliding end of the inner tube is also oval. By rotating the inner tube with respect to the outer tube, the length of the telescoping section may be locked without the use of a jam nut. Preferably there are spiral wound flexible casings on either end of the telescoping section.

### **Drawing**

**[0010]** The invention will be better understood by reference to the following description, taken in connection with the accompanying drawings, in which:

**[0011]** **Fig. 1** is an elevation view of the extendible flexible electrical conduit in accordance with the present invention,

**[0012]** **Fig. 2** is a partial view in cross section, illustrating the construction at the interfaces of the telescoping middle section with the flexible casing sections attached

thereto,

[0013] **Fig. 3** is an enlarged plan view in cross section taken along lines III-III of **Fig. 2**,

[0014] **Fig. 4** is an enlarged plan view in cross section, taken along lines IV-IV of **Fig. 2**,

[0015] **Fig. 5** is an enlarged plan view in cross section, taken along the same plane as **Fig. 4**, but with inner and outer tubes rotated with respect to one another,

[0016] **Fig. 6** is an enlarged elevation view of four helically wound conductors interspersed with one another, and

[0017] **Fig. 7** is an enlarged elevation view of five conductors spirally wound into a single multi-strand conductor in the form of a helix.

#### **Detailed Description of the Preferred Embodiment**

[0018] Referring now to **Fig. 1** of the drawing, an extendible flexible electrical conduit is shown generally at **10**, which comprises a first spiral wound flexible casing **12**, a second spiral wound flexible casing **14**, and a rigid telescoping middle section **16** connected between flexible casings **12** and **14**. The flexible casings **12** and **14** are of a construction well known in the art, consisting of a spirally wound spring with formed metal wire separating the coils of the spring creating friction between spring and formed wire, so that the casing may be bent in any direction and will retain its bent shape as illustrated in the drawing.

[0019] The telescoping middle section **16** comprises an inner tube **18** and an outer tube **20**. The outer tube **20** has an expanded (swaged) attachment end **22** and an expanded free end **24**. The inner tube **18** has an expanded attachment end **26** and a free end (not shown in **Fig. 1**) that slides in close contact within outer tube **20** so that the middle section **16** can extend and contract.

[0020] For reasons later to be explained, the invention may include an indicia line **28** inscribed on the inner tube and a pointer **30** inscribed on the outer tube. A group of insulated electrical conductors **32** extend through flexible casing **12**, telescoping middle section **16**, and flexible casing **14**.

[0021] Referring to **Fig. 2** of the drawing, portions of the conduit are illustrated in enlarged cross sectional views at the connection between the first (upper) flexible casing **12** and inner tube **18**, and also between the second (lower) flexible casing **14**

and the outer tube 20.

[0022] The arrangement of electrical conductors may take several forms. In Fig. 2, there are two insulated conductors 32a, 32b running through the upper flexible casing 12 and held within a plastic retaining ring 34. Conductors 32a, 32b are interleaved with one another and formed into a helical coil 36, which extends most of the length of the telescoping middle section 16. The conductors are attached to another retaining ring 38, and from there pass through the lower flexible casing 14. Retaining rings 34, 38 are dimensioned to fit tightly within the expanded sections 26, 22 of the inner and outer tubes 18, 20 respectively. A bushing 40 of plastic material is disposed in the expanded section 24 of outer tube 20, to receive the inner tube 18, so that tubes 18, 20 will slide easily within one another.

[0023] In accordance with one aspect of the present invention, portions of the inner and outer tubes are made to be non-circular so as to limit rotation about their axes relative to one another. Although the non-circularity may take several forms, the preferred embodiment makes the cross section of the outer tube 20 oval along the major length thereof between attachment end 22 and free end 24. In addition, a relatively short portion of the free end of inner tube 18 (designated by reference number 42 in Fig. 2) is also made oval with the same outline as outer tube 20 but forming close clearance therewith.

[0024] Reference to Figs. 3 and 4 of the drawings illustrate the preferred form of the invention. In Fig. 3, a conductor 32a of helix 36 is seen inside the circular cross section of inner tube designated at 18a. The cross section of the outer tube designated at 20a has a slightly oval or elliptical cross section with major axis 44 and minor axis 46.

[0025] Referring to Fig. 4 of the drawings, taken through the free end 42 of the inner tube as shown in Fig. 2, a conductor 32a of the helix 36 is disposed inside free end 42, which is oval or elliptical in cross section as indicated at reference number 18b. The outer tube 20 is also elliptical in cross section as indicated at reference 20b. Both the ellipses of 18b and 20b have the same major axis 44 and minor axis 46. When the major and minor axes 44, 46 are aligned, the inscribed line 28 and pointer 30 (Fig. 1) appear as shown, and the middle telescoping assembly will freely extend and contract while the helix 36 of conductors 32a, 32b will also extend and contract to accommodate the movement.

[0026] Reference to **Fig. 5** illustrates the same cross section as **Fig. 4**, but with inner and outer tubes **18, 20** rotated about their longitudinal axis with respect to one another, so that the major axis of elliptical inner tube free end, designated **44a** is rotated with respect to the major axis of elliptical outer tube **20b**, as indicated at **44b**. In this position there is interference between the walls of inner and outer tubes and they will not slide longitudinally with respect to one another. Thus rotation will lock the tubes so that the middle section cannot extend or contract until the indices **28, 30** are again aligned. This is a useful feature for a microphone holder, lamp or other device and obviates the need for a jam nut as in prior art devices.

[0027] The arrangement of the conductors inside the telescoping middle section **16** can take several forms without departing from the scope of the present invention. In its simplest form, the conductors may simply be wadded or jumbled up inside the inner tube in a random fashion, or they may be arranged in a zig-zag or helical fashion. The preferred embodiment utilizes a helical arrangement to prevent possibility of entanglement.

[0028] **Fig. 6** of the drawing shows one arrangement wherein the conductors are separately insulated and interleaved with one another in a helical arrangement. These are shown as conductors **48a, 48b, 48c, 48d** which are interleaved into a single interleaved helix **48**.

[0029] Referring to **Fig. 7** of the drawing, individual conductive strands **50a - 50e** are spirally wound into a single multi-strand conductor **50** which is again shaped as a helix in a preferred form of the invention.

### **Operation**

[0030] The components are assembled as described and indicated in **Figs. 1** and **2**. The free ends of the flexible casings **12, 14** may be attached to the desired components and the conductors **32** connected in a conventional fashion. For example, flexible casing **14** might be connected to a support for a microphone podium, while a microphone would be attached to the free end of casing **12**. The spiral construction of the flexible casings serves to dampen and reduce any shocks or vibration between the podium and the microphone.

[0031] The telescoping middle section **16** may be extended or contracted to provide the proper length, while the flexible casings **12, 14** are bent manually to

conform to a desired shape, which they will retain. The inner tube **18** may then be rotated with respect to outer tube **20** to lock the telescoping mid-section in the desired position. Thus the invention provides an improved functionality and is adaptable to a great many devices requiring an extendible flexible electrical conduit with conductors therein.

**[0032]** While the invention is shown in its preferred form with flexible casings attached on either end of a telescoping middle section, it is within the scope and purview of the present invention to utilize only one such flexible casing to obtain universal bending action in combination with length extension. Thus, a single spiral casing might be used on the lower end to attach to a support, while a lamp or microphone might be attached to the upper end, either with or without a pivot connection. Conversely a pivot or swivel connection could directly connect the telescoping section to a support, and a spiral casing used at the upper end to obtain directional placement of a microphone or lamp.

**[0033]** Other modifications will occur to those skilled in the art, and it is desired to secure in the appended claims all such modifications as fall within the true spirit and scope of the invention.